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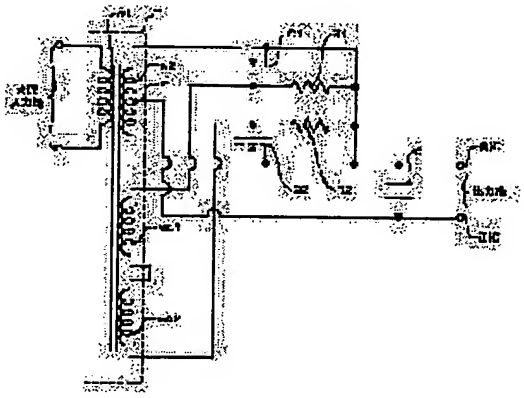
(54) CURRENT DETECTION DEVICE AND POWER SUPPLY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a current detection device capable of sensitively detecting a current flowing through a load without changing the current, and to provide a power supply device having no large loss without changing the current flowing through the load.
SOLUTION: In this current detection device, detection windings wd1, wd2 of a transformer T are induction-coupled with a primary winding w1, and are connected in cascade such that electromotive forces mutually induced in the respective windings wd1, wd2 counteract each other. When a current transiently flows through the secondary winding w2, respective ends of the series circuit of the detection windings wd1, wd2 generate a voltage to turn on one of field effect transistors Q1, Q2 and to turn off the other according to a direction of the transient current, such that a voltage having prescribed polarity is generated between respective electrodes of output terminals of a rectification circuit. In the absence of a successive current in a load, both of the field effect transistors Q1, Q2 are turned off.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to current detection equipment and a power unit.
[0002]
[Description of the Prior Art] The technique of detecting the currents (a power-source current, signal current, etc.) which flow for a load is used widely, and the detection result of a current is used for a power unit, control of the source of a signal, etc. As the technique of detecting the current which flows for a load, the technique of forming a current transformer in the current supply source way from a power source to a load and the technique of inserting a resistor with low enough resistance in a current supply source way are common.
[0003] By the technique using a current transformer, the primary winding of a current transformer is inserted in a current supply source way, and the signal of the magnitude proportional to the load current is taken out from the secondary winding of this current transformer. Moreover, by the technique using a resistor, a resistor is inserted in a current supply source way, and the load current is detected by measuring the electrical potential difference between the ends of this resistor.
[0004]
[Problem(s) to be Solved by the Invention] Also in which above-mentioned technique, a current transformer and a resistor serve as a value in which the magnitude of the current which flows for a load differed from the magnitude of the current which should flow essentially, in order that these very thing may consume power. For this reason, in order to make it stop within limits which the effect which it has on the current to which a current transformer and a resistor flow for a load can disregard, it is necessary to make power consumption of a current transformer small enough, or to make the resistance of a resistor sufficiently small.
[0005] However, if it is necessary to increase the number of turns of the secondary winding of a current transformer and the number of turns of the secondary winding of a current transformer increase in order to raise the sensibility of a current transformer, change of the current which the consumption of the power by the secondary transformer itself increases, therefore flows for a load will become large.
[0006] Moreover, the electrical potential difference between the ends of the resistor inserted in the current supply source way to a load increases in proportion to the magnitude of the resistance of this resistor. However, since the power which this resistor consumes also increases so that resistance becomes large, change of the current which flows for a load becomes large.
[0007] Moreover, in order that a current transformer may act as inductive load, in view of the supply source of a current, the supply source of a current will supply power to the series circuit of the inductive load which a current transformer forms, and the load of the object to drive. Therefore, a component with a higher frequency becomes that a load is hard to be supplied among the currents which should be passed for a load, and aggravation of the frequency characteristics of the current which flows for a load is caused.
[0008] This invention was made in view of the situation mentioned above, does not change the current

which flows for a load, and aims at offering the current detection equipment which makes it possible to detect a current to high sensitivity. Moreover, this invention aims at offering the current detection equipment which makes it possible to detect a current, without worsening the frequency characteristics of the current which flows for a load. Moreover, this invention also makes it the object not to change the current which flows for a load and to offer a power unit with little loss.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned object, the current detection equipment by the 1st viewpoint of this invention It has a transformer equipped with a primary winding and the secondary winding by which inductive coupling was carried out to said primary winding, and the coil for detection of the couple by which inductive coupling was carried out to said primary winding. Each aforementioned coil for detection It connects with the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, a series circuit is formed, and each edge of this series circuit is characterized by what the current element for detecting the current which flows to said secondary winding is formed for.

[0010] Since induction of the electromotive force by which induction is carried out to the coil for detection is carried out by the current which flows to a primary winding according to such current detection equipment, the current which the current which flows for the load connected among the ends of a secondary winding does not change substantially, and flows for a load by desired sensibility is detected. Moreover, according to such current detection equipment, since a current common to the coil for detection and a secondary winding does not flow, the frequency characteristics of the current which flows for a load are not worsened.

[0011] Moreover, the current detection equipment by the 2nd viewpoint of this invention It is current detection equipment for detecting the current which flows to said secondary winding of a transformer equipped with a primary winding and the secondary winding by which inductive coupling was carried out to said primary winding. It has the coil for detection of the couple by which inductive coupling was carried out to said primary winding. Each aforementioned coil for detection It connects with the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, a series circuit is formed, and each edge of this series circuit is characterized by what the current element for detecting the current which flows to said secondary winding is formed for.

[0012] Since induction of the electromotive force by which induction is carried out to the coil for detection also with such current detection equipment is carried out by the current which flows to the primary winding of a transformer, the current which the current which flows for the load connected among the ends of the secondary winding of a transformer does not change substantially, and flows for a load by desired sensibility is detected. Moreover, with such current detection equipment, since a current common to the coil for detection and a secondary winding does not flow, the frequency characteristics of the current which flows for a load are not worsened, either.

[0013] Moreover, the power unit by the 3rd viewpoint of this invention A primary winding and the secondary winding by which inductive coupling is carried out to said primary winding, and the self tap which forms one pole of an outgoing end is mostly prepared in the middle point, The coil for detection of the couple which inductive coupling is carried out to said primary winding with preparation ********, is connected to the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, and forms the series circuit, The 1st switching means which is equipped with the current path and control edge which were connected between the end of said secondary winding, and the pole of another side of an outgoing end, answers the signal supplied to the control edge of self, and turns on and turns off each one of current paths substantially, The 2nd switching means which is equipped with the current path and control edge which were connected between the other end of said secondary winding, and the pole of said another side of an outgoing end, answers the signal supplied to each one of control edges, and turns on and turns off each one of current paths substantially, It is based on the electrical potential difference

of each edge of said series circuit. The inside of the current path of each aforementioned switching means, So that said current path which whether there are some which are connected to the edge of said secondary winding which is generating the polar predetermined electrical potential difference distinguished, and was distinguished when it connected may turn on and said other current paths may turn off It is characterized by having the control means which supplies a signal to the control edge of each aforementioned switching means.

[0014] According to such a power unit, intermittence of the current path of the 1st and 2nd switching means is determined as each coil for detection based on the electromotive force by which induction is carried out. And since induction of the electromotive force by which induction is carried out to the coil for detection is carried out by the current which flows to the primary winding of a transformer, the current which flows for the load connected among the ends of the secondary winding of a transformer does not change substantially. Moreover, since each of each current paths of the 1st and 2nd switching means turns off when a load is not substantially connected to the secondary winding of a transformer and a polar predetermined electrical potential difference does not occur at the end of any of a series circuit, generating of loss of the power by leakage current etc. is prevented.

[0015] Said 1st switching means may consist of the 1st field-effect transistor equipped with a drain, the source, and the gate. In this case, said the 1st drain and source of a field-effect transistor make the ends of the current path of said 1st switching means, and the gate of nothing and said 1st field-effect transistor should just make the control edge of said 1st switching means. Moreover, said 2nd switching means may consist of the 2nd field-effect transistor equipped with a drain, the source, and the gate. And said the 2nd drain and source of a field-effect transistor shall make the ends of the current path of said 2nd switching means, and the gate of nothing and said 2nd field-effect transistor shall just make the control edge of said 1st switching means.

[0016] When the signal which makes a self current path turn on is not supplied to the control edge of self, said 1st and 2nd switching means When induction of the electromotive force of the sense which passes a current to the predetermined sense is carried out to said secondary winding at said secondary winding, If it shall have an initial current passage means to bypass a self current path and to pass a current transitionally to said secondary winding The electrical potential difference rectified by the load is supplied by impressing a single-phase alternative current electrical potential difference among the ends of a primary winding, where a load is connected among the ends of a secondary winding, without requiring performing the procedure of initialization to others.

[0017] Said initial current passage means shall be in parallel with the current path of the 1st rectifying device connected to juxtaposition at the current path of said 1st switching means, and said 2nd switching means, and shall just be equipped with the 2nd rectifying device connected to sense to which the forward current which flows to self flows to said secondary winding as forward current of said 1st rectifying device, and the capacitor connected among the two poles of said outgoing end, for example.

[0018]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is made as the transformer for load current detection, a rectifier circuit is made into an example, and it explains with reference to a drawing.

(Gestalt of the 1st operation) Drawing 1 is the sectional view showing typically the cross section of the transformer T for load current detection concerning the gestalt of implementation of the 1st of this invention.

[0019] Transformer T consists of an iron core F, a primary coil w1, a secondary winding w2, and coils wd1 and wd2 for detection, as shown in drawing 1 .

[0020] The iron core F consists of EI type cores which are illustrated, for example. It is put together and the EI type core is constituted so that it may illustrate, and an "E" character-like core and an "I" character-like core may make the shape of a "day" character.

[0021] an "E" character-like core is set up at a right angle to the ends of the straight-line-like yoke section 5 and the yoke section 5 at the longitudinal direction of the yoke section 5 -- having -- mutual -- parallel -- and the periphery legs 7 and 8 of the vertical couple arranged by confronting each other up

and down and the central leg 9 which protrudes on the periphery legs 7 and 8 and parallel in the center of the yoke section 5 -- since -- it is constituted. The "I" character-like core consists of the straight-line-like yoke sections 6.

[0022] The central leg 9 of the core of the shape of an "E" character of an iron core F is looped around a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection so that it may illustrate. specifically, a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection are illustrated -- as -- the order from the one where an inside diameter is smaller -- the coil wd1 for detection, a primary winding w1, a secondary winding w2, and the coil wd2 for detection -- becoming -- making -- each and the central leg 9 -- almost -- the whole surface -- a wrap -- the central leg 9 is looped around like.

[0023] As shown in drawing 1 , the ends of a primary winding w1 form the input edge for supplying power sources, such as for example, a commercial alternating current power source. The ends of a secondary winding w2 form the outgoing end for supplying power to a load. When alternating voltage is impressed to the primary winding w1 of each ends of the coils wd1 and wd2 for detection, 1 set of edges are mutually connected among 2 sets of edges which consist of edges which generate the electrical potential difference of like-pole nature. Other 1 set forms a current detection terminal.

[0024] Next, actuation of the transformer T of drawing 1 is explained. If the supply voltage of a single-phase alternative current is supplied between the input edges of Transformer T (namely, between the ends of a primary winding w1) where the load Zd for detection is connected to the ends of a current detection terminal, a primary winding w1 will generate the magnetic flux which has the distribution shown in drawing 2 .

[0025] The magnetic flux which a primary winding w1 generates results in opening of another side of this solenoid through the exterior of this solenoid, passes through the interior of this solenoid further, and returns from one opening of the solenoid which a primary winding w1 forms to one opening of this solenoid so that it may illustrate. Therefore, the magnetic flux which a primary winding w1 generates passes also through each interior of the solenoid which the solenoid which a secondary winding w2 forms, the solenoid which the coil wd1 for detection forms, and the coil wd2 for detection form.

[0026] For this reason, between the outgoing ends of Transformer T (namely, between the ends of a secondary winding w2), the electrical potential difference induction is carried out [an electrical potential difference] to a secondary winding w2 by the magnetic flux which a primary winding w1 generates occurs. This electrical potential difference turns into a single-phase alternative current electrical potential difference which has the actual value proportional to the actual value of the single-phase alternative current electrical potential difference impressed between the input edges of Transformer T.

[0027] Moreover, among the ends of a current detection terminal, an equal electrical potential difference occurs substantially to the difference of the electrical potential difference in which induction is carried out to the coil wd1 for detection by the magnetic flux which a primary winding w1 generates, and the electrical potential difference in which induction is carried out to the coil wd2 for detection by the magnetic flux which a primary winding w1 generates.

[0028] And in the closed circuit which the coils wd1 and wd2 for detection and the resistor Rd for detection form, the current of the magnitude substantially proportional to the electrical potential difference between the ends of a current detection terminal flows. Moreover, if the load which contains a pure resistance component between the outgoing ends of Transformer T is connected, the load current will flow to the load and secondary winding w2, and the load will consume power.

[0029] Then, a secondary winding w2 and the coils wd1 and wd2 for detection make each generate magnetic flux which negates the magnetic flux which a primary winding w1 generates according to the current which flows to each one. That is, the direction where the magnetic flux which a secondary winding w2 and the coils wd1 and wd2 for detection generate passes through the interior of the central leg 9 of an iron core F is hard flow as substantially as the direction where the magnetic flux which a primary winding w1 generates passes through the interior of the central leg 9 of an iron core F. And when magnitude of the magnetic flux which a primary winding w1, a secondary winding w2, and the

coils wd1 and wd2 for detection generate is set to phi1, phi2, phid1, and phid2 at order, the relation between phi1, phi2, phid1, and phid2 which shows in a formula 1 is.
[0030]
[Equation 1] phi1=phi2+phid1+phid2[0031] On the other hand, when the interior of the solenoid of number of turns n, a radius r, and die-length d is filled with the matter of permeability mu, when the current of I flows [magnitude] to this solenoid, magnitude phi of the magnetic flux which this solenoid generates is expressed to it by the formula 2.
[0032]
[Equation 2] phi=(micro-n2, pi-r2, andI)/d [0033] Therefore, the number of turns of a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection It is referred to as n1, n2, nd1, and nd2 at order. The radius of a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection It is referred to as r1, r2, rd1, and rd2 at order, and the relation which shows it in a formula 3 substantially when magnitude of the current which flows to a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection is set to I1, I2, Id1, and Id2 at order is materialized. However, let mutually substantially the die length of each solenoid which a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection form be an equal.
[0034]
[Equation 3]
n1, r12, I1 = {d/(micro-pi)} - (L1, I1/n1)
= n2, r22, andI2+(nd1, rd12, Id1)+ (nd2, rd22, Id2)
= {d/(micro-pi)}
x {(L2, I2/n2) +(Ld1, Id1/nd1)+ (Ld2, Id2/nd2)}
(Correcting, L1, L2, Ld1, and Ld2 are the self-inductance of a primary winding w1, a secondary winding w2, and the coils wd1 and wd2 for detection)
[0035] A current common to the coils wd1 and wd2 for detection flows, and the common current concerned generates the magnetic flux of sense which negates the magnetic flux which each generates in the coils wd1 and wd2 for detection. Therefore, the relation substantially shown in a formula 4 is materialized.
[0036]
[Equation 4] Id1= {(L2, I2/n2) - (L1, I1/n1)} / {(Ld2/nd2) - (Ld1/nd1)}
[0037] As shown in a formula 4, the current which flows to the coils wd1 and wd2 for detection increases to the variation of the load current which flows to a secondary winding w2 proportionally substantially.
[0038] Since induction of the electromotive force by which induction is carried out to the coils wd1 and wd2 for detection of the transformer T of drawing 1 is carried out by the current which flows to a primary winding w1, the current which flows for the load connected among the ends of a secondary winding wd2 does not have substantially receiving change by the current which flows to the coils wd1 and wd2 for detection. For this reason, the current which flows by desired sensibility for the load connected among the ends of a secondary winding w2 is detectable by enlarging enough the number of turns of the coils wd1 and wd2 for detection. Moreover, since the current which flows to the coils wd1 and wd2 for detection does not say that it flows common to a secondary winding w2, the situation where the frequency characteristics of the current which flows for a load according to the current which flows to the coils wd1 and wd2 for detection get worse is not produced substantially, either.
[0039] (Gestalt of the 2nd operation) Drawing 3 shows typically the configuration of the rectifier circuit concerning the gestalt of implementation of the 2nd of this invention. This rectifier circuit consists of Transformer T, field-effect transistors Q1 and Q2, resistors R1 and R2, and a capacitor C so that it may illustrate.
[0040] a thing [in / in Transformer T / the gestalt of the 1st operation] -- in addition, it has the middle point tap ct connected at the middle point of a secondary winding w2. The ends of the primary winding w1 of Transformer T form the ac input edge. The end of the secondary winding w2 of Transformer T is connected to the drain of a field-effect transistor Q1, and the other end of a secondary winding w2 is

connected to the drain of a field-effect transistor Q2. The middle point tap ct of Transformer T forms the positive electrode of the outgoing end of this rectifier circuit.
[0041] All, field-effect transistors Q1 and Q2 consist of n channel enhancement type MOSFETs (Metal-Oxide-Silicon Field Effect Transistor), and are equipped with the gate, the source, and a drain.
[0042] The drain of a field-effect transistor Q1 is connected to the end of the secondary winding w2 of Transformer T, and the drain of a field-effect transistor Q2 is connected to the other end of the secondary winding w2 of Transformer T. It connects mutually and the source of a field-effect transistor Q1 and the source of a field-effect transistor Q2 form the negative electrode of the outgoing end of this rectifier circuit.
[0043] The gate of a field-effect transistor Q1 is connected to the pole of the direction which the electrical potential difference of straight polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q1 among each pole of the current detection terminal of Transformer T becomes negative polarity. The gate of a field-effect transistor Q2 is connected to the pole of the direction which the electrical potential difference of straight polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q2 among each pole of the current detection terminal of Transformer T becomes negative polarity.
[0044] Capacitor C is for graduating the electrical potential difference (rectification electrical potential difference) of the outgoing end of this rectifier circuit, and is connected between the positive electrode of the outgoing end of this rectifier circuit, and the negative electrode.
[0045] A resistor R1 is for supplying bias voltage to the gate of a field-effect transistor Q1, and is connected between the gate of a field-effect transistor Q1, and the source. A resistor R2 is for supplying bias voltage to the gate of a field-effect transistor Q2, and is connected between the gate of a field-effect transistor Q1, and the source.
[0046] The resistance of a resistor R1 is chosen as extent with which bias voltage which makes a field-effect transistor Q1 turn on is impressed between the gate-sources of a field-effect transistor Q1 by the sufficiently high value when a current flows for the capacitor C connected among the two poles of the outgoing end of this rectifier circuit, and/or a load. The resistance of a resistor R2 is chosen as extent with which bias voltage which makes a field-effect transistor Q2 turn on is impressed between the gate-sources of a field-effect transistor Q2 by the sufficiently high value when a current flows for the capacitor C connected among the two poles of the outgoing end of this rectifier circuit, and/or a load.
[0047] If the single-phase alternative current electrical potential difference of the rectifying object is impressed among the two poles of the ac input edge of this rectifier circuit, induction of the electrical potential difference will be carried out by mutual induction among the ends of the secondary winding w2 of Transformer T, the end of a secondary winding w2 will serve as straight polarity to the potential of the middle point tap ct of Transformer T, and another side will serve as negative polarity.
[0048] And hereafter, in order to make an understanding easy, suppose that the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q1 among the ends of a secondary winding w2 became negative polarity to the potential of the middle point tap ct. In this case, from the source of a field-effect transistor Q1, a current flows to a secondary winding w2 so that it may pass through the parasitism diode between the source-drains of a field-effect transistor Q1, the secondary winding w2 of Transformer T, the middle point tap ct, and Capacitor C in order.
[0049] Then, the current which reaches the pole of the direction connected to the gate of a field-effect transistor Q2 among the two poles of a current detection terminal through the resistor R1 and the resistor R2 in order increases from the pole of the direction which the electrical potential difference between the two poles of a current detection terminal changed, consequently was connected to the gate of a field-effect transistor Q1 among the two poles of a current detection terminal. Consequently, the field-effect transistor Q1 to which the electrical potential difference between the ends of a resistor R1 is impressed between the gate-sources of self is turned on, and turns off the field-effect transistor Q2 to which the electrical potential difference between the ends of a resistor R2 is impressed between the gate-sources of self.

[0050] Then, a current flows to a secondary winding w2 so that it may pass through the edge of the direction connected to the drain of a field-effect transistor Q1 among the ends of Capacitor C, the source of a field-effect transistor Q1 and a drain, and a secondary winding w2 in order from the middle point tap ct of Transformer T.
[0051] When the load is not connected among the ends of this rectifier circuit at this time, after charge of Capacitor C is completed substantially, the current concerned which flows to a secondary winding w2 will not flow substantially. Then, the current which flows to the coils wd1 and wd2 for detection decreases, and the magnitude of the voltage drop between the ends of a resistor R1 also decreases. Consequently, a field-effect transistor Q1 is turned off. On the other hand, if the load is connected among the ends of this rectifier circuit, also even in after charge termination of Capacitor C, a current will continue flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q1 of Transformer T.
[0052] Moreover, from the source of a field-effect transistor Q2, when the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q2 among the ends of a secondary winding w2 becomes negative polarity to the potential of the middle point tap ct, a current flows to a secondary winding w2 so that it may pass through the middle point tap ct and Capacitor C of the parasitism diode between the source-drains of a field-effect transistor Q2, and Transformer T in order.
[0053] Then, the electrical potential difference between the two poles of a current detection terminal changes, and the current which reaches the pole of the direction connected to the gate of a field-effect transistor Q1 among the two poles of a current detection terminal through the resistor R2 and the resistor R1 in order increases from the pole of the direction connected to the gate of a field-effect transistor Q2 among the two poles of a current detection terminal. Consequently, a field-effect transistor Q1 is turned off and turns on a field-effect transistor Q2. Therefore, from the source of a field-effect transistor Q2, a current flows to a secondary winding w2 so that it may pass through the drain of a field-effect transistor Q2, the middle point tap ct of Transformer T, and Capacitor C in order.
[0054] When the load is not connected among the ends of this rectifier circuit at this time, after charge of Capacitor C is completed substantially, to a secondary winding w2, a current will not flow substantially, and a field-effect transistor Q2 turns off. On the other hand, if the load is connected among the ends of this rectifier circuit, also even in after charge termination of Capacitor C, a current will continue flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q2 of Transformer T.
[0055] In the rectifier circuit of drawing 3 , induction of the electromotive force by which induction is carried out to the coils wd1 and wd2 for detection of the transformer T made to generate the electrical potential difference which opts for ON or OFF of field-effect transistors Q1 and Q2 is carried out by the current which flows to a primary winding w1. For this reason, the current which flows for the load connected among the ends of a secondary winding wd2 does not have substantially receiving change by the current which flows to the coils wd1 and wd2 for detection.
[0056] Moreover, a load is not substantially connected to the secondary winding w2 of Transformer T, but when an electrical potential difference which makes a field-effect transistor Q1 or Q2 turn on has not arisen at the end of any of a current detection terminal, field-effect transistors Q1 and Q2 turn each off. For this reason, risk of power being consumed according to the leakage current between the drain-sources of field-effect transistors Q1 and Q2 etc. is prevented.
[0057] In addition, the configuration of this rectifier circuit is not restricted to an above-mentioned thing. For example, as field-effect transistors Q1 and Q2 are shown in drawing 4 , all may consist of p channel MOS FET.
[0058] When it has the configuration of drawing 4 , the connected source of a field-effect transistor Q1 and the source of a field-effect transistor Q2 form the positive electrode of the outgoing end of this rectifier circuit so that it may illustrate. And the gate of a field-effect transistor Q1 is connected to the pole of the direction which the electrical potential difference of negative polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q1

among each pole of the current detection terminal of Transformer T becomes straight polarity. Moreover, the gate of a field-effect transistor Q2 is connected to the pole of the direction which the electrical potential difference of negative polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q2 among each pole of the current detection terminal of Transformer T becomes straight polarity.

[0059] Among the two poles of the ac input edge of the rectifier circuit of drawing 4 , the single-phase alternative current electrical potential difference of the rectifying object is impressed, and suppose that the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q1 among the ends of a secondary winding w2 became straight polarity to the potential of the middle point tap ct. In this case, a current flows from the secondary winding w2 of Transformer T to a secondary winding w2 through the middle point tap ct of the drain of a field-effect transistor Q1, the parasitism diode between the drain-sources of a field-effect transistor Q1, Capacitor C, and Transformer T in order.

[0060] Then, the electrical potential difference between the two poles of a current detection terminal changes, and the current which reaches the pole of the direction connected to the gate of a field-effect transistor Q1 among the two poles of a current detection terminal through the resistor R2 and the resistor R1 in order increases from the pole of the direction connected to the gate of a field-effect transistor Q2 among the two poles of a current detection terminal. Consequently, a field-effect transistor Q1 is turned on and turns off a field-effect transistor Q2. Consequently, a current flows from the secondary winding w2 of Transformer T to a secondary winding w2 through the middle point tap ct of the drain of a field-effect transistor Q1 and the source, Capacitor C, and Transformer T in order.

[0061] And when the load is not connected among the ends of this rectifier circuit, a current will not flow substantially to a secondary winding w2 by termination of charge of Capacitor C, and a field-effect transistor Q1 is turned off. When the load is connected, a current continues flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q1 of Transformer T.

[0062] Moreover, suppose that the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q2 among the ends of a secondary winding w2 became straight polarity to the potential of the middle point tap ct. In this case, a current flows from the secondary winding w2 of Transformer T to a secondary winding w2 through the middle point tap ct of the drain of a field-effect transistor Q2, the parasitism diode between the drain-sources of a field-effect transistor Q2, Capacitor C, and Transformer T in order.

[0063] Then, from the pole of the direction connected to the gate of a field-effect transistor Q1 among the two poles of a current detection terminal, the current which reaches the pole of the direction connected to the gate of a field-effect transistor Q2 among the two poles of a current detection terminal through the resistor R1 and the resistor R2 in order increases, a field-effect transistor Q2 turns on, and a field-effect transistor Q1 turns off. Consequently, a current flows from the secondary winding w2 of Transformer T to a secondary winding w2 through the middle point tap ct of the drain of a field-effect transistor Q2 and the source, Capacitor C, and Transformer T in order.

[0064] And when the load is not connected among the ends of this rectifier circuit, after charge of Capacitor C is completed, when a field-effect transistor Q2 turns off and the load is connected, a current continues flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q2 of Transformer T.

[0065] Moreover, this rectifier circuit may have the configuration shown in drawing 5 . The configuration of the rectifier circuit of drawing 5 is substantially [as the configuration of the rectifier circuit of drawing 3] the same except for the point described below.

[0066] However, as shown in drawing 5 , this rectifier circuit is looked like [Transformer T field-effect transistors Q1 and Q2, resistors R1 and R2, and Capacitor C], in addition is equipped with bipolar transistors Q3 and Q4 and resistors R3 and R4. All, bipolar transistors Q3 and Q4 consist of bipolar transistors of an PNP mold, and are equipped with the base, an emitter, and a collector. Moreover, field-effect transistors Q1 and Q2 are constituted from a p channel enhancement type MOSFET by each.

[0067] In the rectifier circuit of drawing 5 , the pole of the direction which the electrical potential

difference of straight polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q1 among each pole of the current detection terminal of Transformer T becomes negative polarity is replaced with the gate of a field-effect transistor Q1, and is connected to the base of a bipolar transistor Q4. The pole of the direction which the electrical potential difference of straight polarity generates when the end of the secondary winding of the transformer T connected to the drain of a field-effect transistor Q2 among each pole of the current detection terminal of Transformer T becomes negative polarity is replaced with the gate of a field-effect transistor Q2, and is connected to the base of a bipolar transistor Q3.

[0068] The collector of a bipolar transistor Q3 is connected to the gate of a field-effect transistor Q1. The emitter of a bipolar transistor Q3 is connected to the middle point tap ct of Transformer T. The collector of a bipolar transistor Q4 is connected to the gate of a field-effect transistor Q2. The emitter of a bipolar transistor Q4 is connected to the middle point tap ct of Transformer T.

[0069] The resistor R3 is connected between the base of a bipolar transistor Q3, and an emitter. The resistor R4 is connected between the base of a bipolar transistor Q4, and an emitter.

[0070] When a current flows for the capacitor C connected among the two poles of the outgoing end of this rectifier circuit, and/or a load, the resistance of resistors R3 and R4 is chosen so that the direction which passes this current that flowed for Capacitor C and/or the load among field-effect transistors Q1 and Q2, and the current of the same direction may be made to turn on by actuation of the after-mentioned [bipolar transistors Q3 and Q4].

[0071] Among the two poles of the ac input edge of the rectifier circuit of drawing 5 , the single-phase alternative current electrical potential difference of the rectifying object is impressed, and suppose that the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q1 among the ends of a secondary winding w2 became negative polarity to the potential of the middle point tap ct. In this case, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through Capacitor C, the parasitism diode between the source-drains of a field-effect transistor Q1, and the drain of a field-effect transistor Q1 in order.

[0072] Then, the current which reaches the pole of the direction connected to the base of a bipolar transistor Q3 among the two poles of a current detection terminal through the resistor R4 and the resistor R3 in order increases from the pole of the direction which the electrical potential difference between the two poles of a current detection terminal changed, consequently was connected to the base of a bipolar transistor Q4 among the two poles of a current detection terminal. Consequently, the bipolar transistor Q3 to which the electrical potential difference between the ends of a resistor R3 is impressed between the base-emitters of self is turned on, and turns off the bipolar transistor Q4 to which the electrical potential difference between the ends of a resistor R4 is impressed between the base-emitters of self.

[0073] Then, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through the emitter of a bipolar transistor Q3 and a collector, a resistor R1, the parasitism diode between the source-drains of a field-effect transistor Q1, and the drain of a field-effect transistor Q1 in order. Consequently, the field-effect transistor Q1 to which the electrical potential difference between the ends of a resistor R1 is impressed between the gate-sources of self is turned on.

[0074] On the other hand, since the bipolar transistor Q4 is turned off, the current path which supplies a current to a resistor R2 is intercepted substantially, and a voltage drop does not generate it substantially in the ends of a resistor R2. Therefore, the field-effect transistor Q2 to which the electrical potential difference between the ends of a resistor R2 is impressed between the gate-sources of self is turned off.

[0075] Then, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through the source and the drain of Capacitor C and a field-effect transistor Q1 in order. As a result of the current which a current will not flow substantially to a secondary winding w2, and flows to the coils wd1 and wd2 for detection decreasing after charge of Capacitor C is completed substantially when the load is not connected among the ends of this rectifier circuit at this time, a field-effect transistor Q1 is turned off. On the other hand, if the load is connected among the ends of this rectifier circuit, also even in after charge termination of Capacitor C, a current will continue flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q1 of Transformer T.

[0076] Moreover, the single-phase alternative current electrical potential difference of the rectifying object is impressed among the two poles of the ac input edge of the rectifier circuit of drawing 5 , and suppose that the electrical potential difference of the edge of the direction connected to the drain of a field-effect transistor Q2 among the ends of a secondary winding w2 became negative polarity to the potential of the middle point tap ct. In this case, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through Capacitor C, the parasitism diode between the source-drains of a field-effect transistor Q2, and the drain of a field-effect transistor Q2 in order.
[0077] Then, the current which reaches the pole of the direction connected to the base of a bipolar transistor Q4 among the two poles of a current detection terminal through the resistor R3 and the resistor R4 in order increases from the pole of the direction connected to the base of a bipolar transistor Q3 among the two poles of a current detection terminal. Consequently, a bipolar transistor Q3 is turned off and turns on a bipolar transistor Q4.
[0078] Then, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through the emitter of a bipolar transistor Q4 and a collector, a resistor R2, the parasitism diode between the source-drains of a field-effect transistor Q2, and the drain of a field-effect transistor Q2 in order. Consequently, a field-effect transistor Q2 is turned on. On the other hand, since it turns off, a bipolar transistor Q3 turns off a field-effect transistor Q1.
[0079] Then, a current flows from the middle point tap ct of Transformer T to a secondary winding w2 through the source and the drain of Capacitor C and a field-effect transistor Q2 in order. As a result of the current which a current will not flow substantially to a secondary winding w2, and flows to the coils wd1 and wd2 for detection decreasing after charge of Capacitor C is completed substantially when the load is not connected among the ends of this rectifier circuit at this time, a field-effect transistor Q2 is turned off. On the other hand, if the load is connected among the ends of this rectifier circuit, also even in after charge termination of Capacitor C, a current will continue flowing to the secondary winding w2 between the drains of the middle point tap ct-field-effect transistor Q2 of Transformer T.
[0080] In addition, this invention is not limited to the gestalt of the above-mentioned implementation, but various deformation and application are possible for it. For example, the configuration of the iron core F of Transformer T, construction material, etc. are arbitrary. Moreover, the location of a coil etc. can be changed suitably. Furthermore, not only the rectifier circuit shown in drawing 3 - drawing 5 but other configurations are employable.
[0081]
[Effect of the Invention] As explained above, according to this invention, the current which flows for a load is not changed and the current detection equipment which makes it possible to detect a current to high sensitivity is realized. Moreover, according to this invention, the current detection equipment which makes it possible to detect a current, without worsening the frequency characteristics of the current which flows for a load is realized. Moreover, according to this invention, the current which flows for a load is not changed and a power unit with little loss is realized.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing typically the cross section of the transformer concerning the gestalt of implementation of the 1st of this invention.
[Drawing 2] It is drawing showing the sense of the line of magnetic force which the primary winding of the transformer of drawing 1 generates.
[Drawing 3] It is the circuit diagram showing the configuration of the rectifier circuit concerning the gestalt of implementation of the 2nd of this invention.
[Drawing 4] It is the circuit diagram showing the configuration of the modification of the rectifier circuit of drawing 3 .
[Drawing 5] It is the circuit diagram showing the configuration of the modification of the rectifier circuit of drawing 3 .
[Description of Notations]
T Transformer
F Iron core
w1 Primary winding
w2 Secondary winding
wd1, wd2 Coil for detection
Q1, Q2 Field-effect transistor
Q3, Q4 Bipolar transistor
C Capacitor
R1-R4 Resistor

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CLAIMS

[Claim(s)]
[Claim 1] It has a transformer equipped with a primary winding and the secondary winding by which inductive coupling was carried out to said primary winding, and the coil for detection of the couple by which inductive coupling was carried out to said primary winding. Each aforementioned coil for detection It is current detection equipment which is connected to the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, forms a series circuit, and is characterized by what each edge of this series circuit forms the current element for detecting the current which flows to said secondary winding for.
[Claim 2] It is current detection equipment for detecting the current which flows to said secondary winding of a transformer equipped with a primary winding and the secondary winding by which inductive coupling was carried out to said primary winding. It has the coil for detection of the couple by which inductive coupling was carried out to said primary winding. Each aforementioned coil for detection It is current detection equipment which is connected to the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, forms a series circuit, and is characterized by what each edge of this series circuit forms the current element for detecting the current which flows to said secondary winding for.
[Claim 3] A primary winding and the secondary winding by which inductive coupling is carried out to said primary winding, and the self tap which forms one pole of an outgoing end is mostly prepared in the middle point, The coil for detection of the couple which inductive coupling is carried out to said primary winding with preparation ********, is connected to the sense which negates mutually the electromotive force in which mutual induction is carried out to each one by the current which flows to said primary winding in a cascade, and forms the series circuit, The 1st switching means which is equipped with the current path and control edge which were connected between the end of said secondary winding, and the pole of another side of an outgoing end, answers the signal supplied to the control edge of self, and turns on and turns off each one of current paths substantially, The 2nd switching means which is equipped with the current path and control edge which were connected between the other end of said secondary winding, and the pole of said another side of an outgoing end, answers the signal supplied to each one of control edges, and turns on and turns off each one of current paths substantially, It is based on the electrical potential difference of each edge of said series circuit. The inside of the current path of each aforementioned switching means, So that said current path which whether there are some which are connected to the edge of said secondary winding which is generating the polar predetermined electrical potential difference distinguished, and was distinguished when it connected may turn on and said other current paths may turn off The power unit characterized by having the control means which supplies a signal to the control edge of each aforementioned switching means.
[Claim 4] Said 1st switching means consists of the 1st field-effect transistor equipped with a drain, the source, and the gate. Said the 1st drain and source of a field-effect transistor the ends of the current path

of said 1st switching mea[redacted]othing, The gate of said 1st field-effect transistor the control edge of said 1st switching means nothing and said 2nd switching means It consists of the 2nd field-effect transistor equipped with a drain, the source, and the gate. It is the power unit according to claim 3 characterized by what said the 2nd drain and source of a field-effect transistor make the ends of the current path of said 2nd switching means, and the gate of nothing and said 2nd field-effect transistor makes the control edge of said 1st switching means for.

[Claim 5] Said 1st and 2nd switching means are power units according to claim 4 characterized by what it has an initial current passage means to bypass a self current path and to pass a current transitionally to said secondary winding for when induction of the electromotive force of the sense which passes a current to said secondary winding at the predetermined sense when the signal which makes a self current path turn on is not supplied to the control edge of self is carried out to said secondary winding.

[Claim 6] Said initial-current passage means is a power unit according to claim 5 characterized by what it has for the 2nd rectifying device connected to sense to which the 1st rectifying device connected to juxtaposition at the current path of said 1st switching means and the forward current which is in parallel with the current path of said 2nd switching means, and flows to self flow to said secondary winding as forward current of said 1st rectifying device, and the capacitor connected among the two poles of said outgoing end.

[Translation done.]

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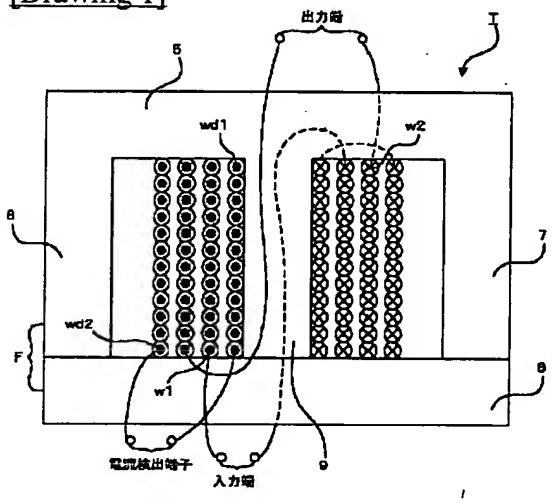
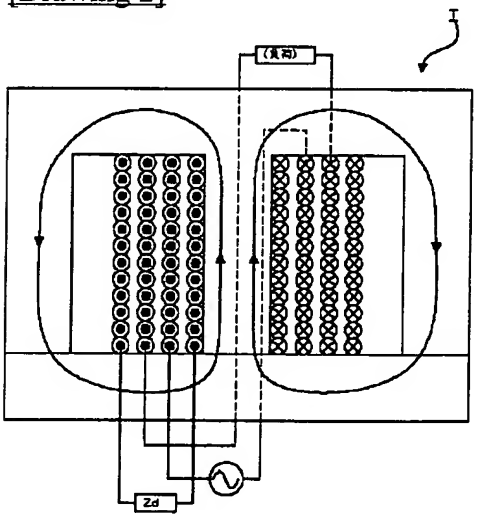
DRAWINGS

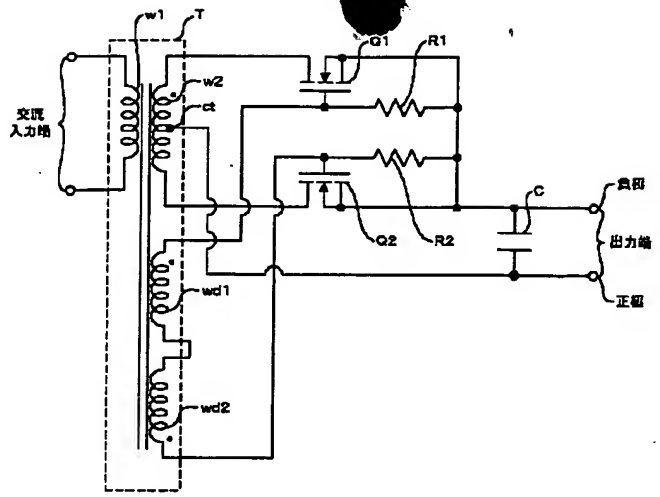
[Drawing 1]



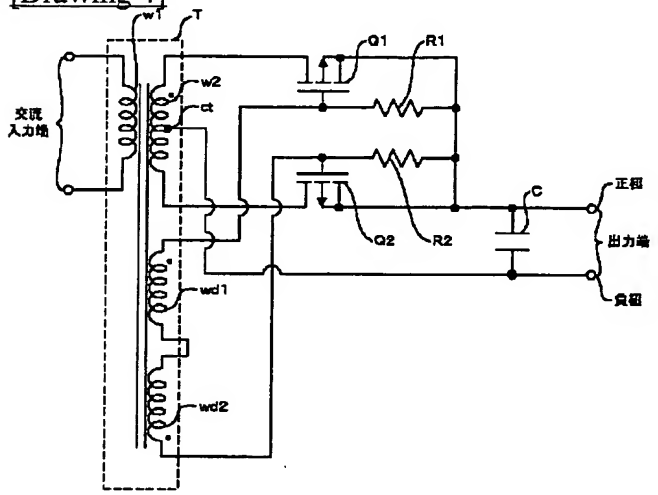
[Drawing 2]



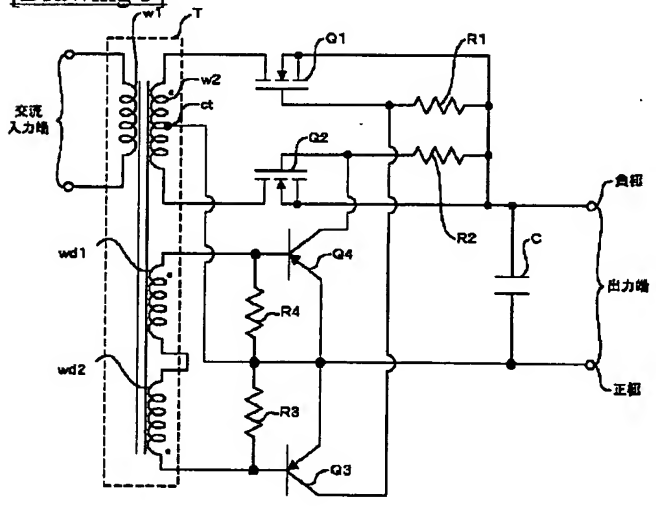
[Drawing 3]



[Drawing 4]



[Drawing 5]



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